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A gift of Rev. P.H. Francis

THE TEMPERATE SUN

by the

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- A Study of Targets in Games
- Mechanical Biology
- The Origins and Developments of Fire Arms and Gunpowder

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PREFACE

The question, "Is the Sun on fire ?" should be asked. It is unscientific to assume it is on fire, and then to build elaborate theories on an untested supposition. The notion of a burning sun should be subjected, like all other popular notions, to the most rigorous questioning it is possible to devise. Far from trying to test the truth of this notion of an incandescent sun, scientists assume it is a burning body.

The popular notion that the sun is on fire is rubbish, and merely a hoary superstition, on a par with a belief in a flat earth, an earth resting on the back of a tortoise or an elephant, or a sun revolving around a stationary earth. It is on this primitive superstition, however, that a great deal of present day scientific philosophy and most solar and stellar theories have been built. It is not to be wondered at, therefore, that scientific philosophies and solar and stellar theories are notable chiefly for their incomprehensibilities, complexities, and difficulties.

There is no warrant for a belief that the scheme of the universe need be beyond the easy grasp of the human mind. It is because initial beliefs are not tested that laws of the universe remain undiscovered, and its scheme perplexing. The problem therefore is, and always will be, to try and examine popular beliefs, and correct them, before starting. This work examines the popular supposition that the sun is on fire, and shows it cannot be correct. Then, by starting from the more correct supposition of a cold or temperate sun, at once it becomes an easy matter to find answers to many problems that hitherto have baffled the most learned researches and the most complicated attempts at solution.

Over a period of many years, the author has searched text books, journals, and other writings to try and discover if anyone has thought it necessary or advisable to test this notion of a hot sun ; but without finding it has been done.

Advances in scientific knowledge are often, indeed nearly always, made not by accepting as true what everybody assumes to be true, but by doubting it and testing it, and then replacing the popular notion by something more correct. Classic examples easily come to the mind. People formerly assumed the earth is flat ; this popular and age-old notion was eventually found to be incorrect. Until a few hundred years ago, people believed the sun moves around the earth. Copernicus said the earth moves around the sun ; but could not persuade many people to think it possible. Galileo doubted the truth of the popular idea that a heavy weight falls to the earth more quickly than a lighter weight, and tested the popular idea for its truth and found it incorrect ; and the science of mechanics then began to make progress.

Laplace and Kant and others abandoned the scientific method when they made no attempt to question the popular notion of a burning sun, and advanced nebular hypotheses for the formation of the heavenly bodies. No astronomer to-day uses the scientific method, if he advances theories of the sun or stars, unless he first subjects the popular notion of a burning sun to the most exhaustive tests. As astronomers do not subject the notion to any form of test, or even think it advisable to test it, there cannot be much dependence on theories erected on the basis of a burning sun.

Nothing should be assumed in science. Everything must be tested. This should be, but is not now, an axiom of science. But some will say that there is plenty of evidence for a burning sun. There is certainly the evidence of what everybody assumes, but that is not trustworthy. Indeed, one can say that if everybody assumes something, it is well worth testing, and will almost certainly be found to be incorrect. We cannot trust the evidence even of our own eyes. Men did this, and for long ages were deluded into assuming the sun moves round the earth. We must doubt even what we see and feel. Because the sun looks hot and we feel it making us hot, we must not rashly assume it is a hot body. That is not science. Copernicus asked people to disbelieve the evidences of their eyes, when he asked them to believe the sun does not move around the earth. Men like Martin Luther called Copernicus "a fool for holding such opinions," and Melanchthon said much the same thing.

Copernicus could not prove the earth moves round the sun. Nor could Kepler; nor could Galileo or Newton. But they gave reasons for doubting whether the popular ideas about the movements of the sun were really correct. The first people who said the earth is not flat but a globe, could not prove it is a globe. Indeed, centuries passed before it was definitely proved to be a globe, by men like Magellan and Drake sailing round it, who "thereby demonstrated, by a palpable experiment, obvious to the grossest and most vulgar capacity, the reality of its long-disputed spherical shape."* The author cannot prove the sun is not on fire. But he can give some reasons for thinking the popular idea of an incandescent sun may be nothing more than a popular superstition handed down from the remote ancestors of the cave man. However, it may not be long before men are compelled to face the question, "Is the sun on fire ?" because space rockets, artificial satellites, and other instruments are being made which will make the truth obvious one way or the other.

Although Copernicus could not prove the earth is in motion around the sun, his theory of a moving earth made the understanding of the motions of the heavenly bodies so easy that its truth forced itself on men's minds. If a new theory brings simplification and understanding where previously there was complexity and mystification, it is probably true. The justification for the truth of the author's theory of a cold or temperate sun is that it allows the easy solution of many previously insoluble problems. Thus, no one now need wonder why the sun's heating powers have never shown signs of diminishing, or why it has not burnt out geological ages ago. Any schoolchild can now estimate accurately how much heat the sun sends each year into space. The answer is no heat at all is sent away from the sun, or received by the earth. Further it becomes easy to understand why hot and cold ages can alternate on the earth; and more important, it can be known that the earth can never become too hot or too cold for life to exist in comfort on it.

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*Anson's Voyage Round the World. Rev. R. Walter, M.A., Chaplain of the Centurion in Anson's Voyage.

The scientists of the time could not accept the theory of Copernicus, because they could not change their ideas ; but they were dealt with by being allowed to die off. Few people of the present generation will be able to realise the sun is not a hot body ; but future generations will be more able to receive the knowledge of a cold or temperate sun.

Again, just before the time of Copernicus, hypotheses to explain the motions of the heavenly bodies had become so complex and difficult that nobody except a few very learned mathematicians could hope to understand them. No hypothesis lasted for long before being replaced by a still more difficult and complex one. Milton refers in Paradise Lost to the amazing learning and ingenuity of the pre-Copernican experts, producing hypotheses and systems to explain the motions :—

> . . . how to build, unbuild, contrive
> To save appearances, how gird the Sphere
> With Centrick and Eccentrick scribl'd o'er
> Cycle and Epicycle, Orb in Orb . . .
>
> Paradise Lost, VIII.

But with the arrival of the simplification allowed by the theory of Copernicus, all the vast learning of the experts was removed to the rubbish heap, and even children could then grasp the plan of the movements of the heavenly bodies. To-day, hypotheses to try to explain how the sun retains its heating powers, how much heat it sends into space, and the alternations of hot and ice ages are beyond the understanding of any except a few learned experts ; and no hypothesis lasts for long before being replaced by another and still more difficult one. This suggests the time is ripe for some simplification which will bring these problems within the easy grasp of the mind.

Many people who have hitherto believed present day astronomical theories to be beyond their understanding will now be surprised and delighted to discover they can know more than the experts, who indeed can never hope to unlearn what they have been taught ; which will be a main reason why the experts will oppose the author's theory, and try to persuade themselves and others that it cannot be true.

It is sensible to be prepared to think the sun may not be on fire, because otherwise we may be taken by surprise by knowledge obtained from space rockets and similar instruments showing it cannot be a hot body. Also, it is the height of foolishness and recklessness to fire men into space, not knowing or even considering if the sun is on fire or not.

It will make a great deal of difference to ideas about space and space travel if it is discovered the sun is not on fire. If this age-old idea of a hot sun is found to be merely a hoary superstition, it may be possible to land on the sun.

One of the greatest risks of space exploration will be removed, if it is known that the sun is not an incandescent body. If it is on fire, obviously space exploration will always be a most dangerous business, for if any space ship or vehicle goes off course, it is likely to be drawn towards the sun, and if the sun is at the tremendous temperature it is said to be, then it will be the end of anything that goes near it. But if it is not on fire, it may be that it will be one of the most suitable places to visit. As, in the olden days, the terrors of the unknown seas gradually disappeared as knowledge of distant places became more full, so terrors of space exploration may disappear as knowledge of the constitution of the heavenly bodies becomes less superstitious and more dependable.

NOTES

The theory of a temperate sun was written, almost as in this work, during the years 1916-1917, and printed as a pamphlet in 1959.

1940-45. Discovery of the ways in which mechanical implements originate and develop, the relationships between inorganic and organic life, and a knowledge of the ways in which materials can be organised to possess the property of life, etc. Printed in "Mechanical Biology" in 1952.

Discovery of the ways in which all types of sports and games originate, develop, and are related. Printed in "A Study of Targets in Games" in 1951.

1947-1959. Publications of new discoveries about weapons and games, and the theory of the sun, in "The Field," "Museums Journal." and various pamphlets, newspapers, and journals.

The books mentioned above are out of print, but copies can be consulted in some libraries.

THE TEMPERATE SUN

DIFFICULTIES CAUSED THROUGH THE NOTION THAT THE SUN IS ON FIRE.

It is assumed by most people that the sun is a fiery body. It is an assumption that has been handed down from primitive man, and is accepted as something that does not need to be tested for its truth. In this short treatise, it will be shown that the notion that the sun is on fire rests on no sure basis of evidence, and that if it is discarded, great simplifications become possible in the sciences of astronomy, geology, and physics, and that many other branches of science can be placed on surer foundations.

Insuperable difficulties have been caused through the thoughtless acceptance of the notion that the sun is a hot body. It has been found impossible, for example, to show why its heating powers have remained constant, how its heat has been maintained, why hot ages and ice ages have not gone to such extremes as to extinguish life on earth, and how heat, electricity, gravitation, and other forms of energy are related. Many of these difficulties disappear when the supposition that the sun is an incandescent body is discarded.

It will be shown there are many reasons for believing the sun is not a ball of fire, but a cool or temperate body, perhaps like the earth, or one of the planets.

How could the sun send heat to the earth ? Between the sun and the earth is a complete vacuum of over ninety million miles, across which no heat could pass. It will be remembered the ordinary household vacuum flask is made on the principle that heat will not cross even a few hundredths of an inch of vacuous space.

Again, we are told by astronomers and physicists that the cold of space is intense ; and that between the earth and the sun there is a cold space of 90,000,000 miles or more. Yet it is assumed that heat from the sun crosses cold space, and then becomes hot again on reaching the earth.

It is colder on the top of a mountain than lower down ; and at the tops of very high mountains it is so cold that the snow there does not melt. And yet heat from the sun is supposed to pass through the cold layers of the upper atmosphere and become warm again as it comes near the earth's surface.

There are other difficulties in the notion of a burning sun.

How could this bonfire have lasted so long ? No satisfactory answer has been given. Some scientists now imagine atomic actions have, in some way, kept up the "fire." But mathematical and physical sciences are too undeveloped to be capable of dealing with the problems that would require to be solved in considering the behaviour of a mass of various incandescent materials and gases of the size of the sun. Further it would be necessary to show, by the same atomic physics, that the sun's output of heat has remained constant during geological ages.

If atomic actions are now affecting the amount of heat the sun sends the earth, why have atomic explosions or actions during the last few geological ages never been sufficiently violent or widespread to endanger life on earth ? It is evidently necessary to think there have been no atomic actions on any considerable scale in the sun at any time during immense past periods of time, otherwise the sun's increased or decreased output of heat would have made the earth so hot or cold as to extinguish life on earth. It is to try and retain the assumption that the sun is a bonfire that scientists have brought in the idea of atomic actions keeping up its heat; but they are under the insuperable difficulty of having to show also that atomic actions must for immense periods of time in the past have been so insignificant that no differences have been caused in its output of heat. Fortunately, complicated theories of atomic actions keeping up the sun's fires are unnecessary, because the sun is not on fire.

The constancy of the sun's heating powers is very remarkable. There is no convincing evidence to show they have varied to any considerable degree since records have been kept. Yet if the sun is a ball of fire, it cannot have continued for so long to send out a constant supply of heat. A bonfire flares up, dies down, flares up again, and eventually dies out. Suppose the sun flared up, even fractionally, the earth would at once become molten or turn into vapour and all life would immediately be extinguished. Suppose it died down, even slightly, the earth would be frozen down to nearly absolute cold, and life would cease to exist. The temperatures between which life on the earth can exist are very close compared with temperature variations that would be caused on the earth by a sun blazing up and dying down. A small variation in the sun's rate of burning would raise or lower temperatures on earth so much that life would disappear on it. Yet, through geological ages, the sun's heating powers have never varied sufficiently to extinguish life, or even to extinguish the higher forms of life which can exist only within a few degrees of temperature variations. The popular idea that the sun is on fire is absurd, on this account alone.

If the sun is a hot body, it is improbable life will exist to-morrow. It is incredible that to-morrow's temperatures on the sun shall remain at just the right degrees to suit life on earth.

It cannot be explained on the assumption that the sun is a burning body why it retains its circular shape. It has the outline of a circular disc, and this outline is never lost or disturbed. This steady retention of a circular outline would be impossible if the sun were a molten tumultuous mass of materials and gases at incredibly high temperatures.

Again, it is difficult to understand why, if the sun is a fiery body, and especially if atomic actions are occurring, it does not hurl parts of itself into space ; and that occasionally or frequently some of the planets are not hit and thrown out of their orbits.

There have been hot ages and ice ages on the earth at various times in the past, but nobody has explained convincingly why they have alternated. Hot ages and ice ages could perhaps be explained as having occurred, on the hypothesis that the sun's fires have flared up and died down at different times. But it would be a dangerous argument to use, because only the very slightest "stoking up" or "dying down" could be admitted as having occurred. Anything beyond these limits would have extinguished life on the earth.

It is as unnecessary to think the sun must be a blazing bonfire in order to heat and light the earth as to imagine an electrical generating station must be on fire in order to heat and light buildings far away. Electrical power can be generated by cold running water, and the machinery in the station can be kept at a low temperature, and the station may be so cold that workmen in it may need artificial heating to keep them warm. There may even be refrigerators in stations that give heat and light to places around them. These facts should help to show that the sun does not necessarily have to be a fiery body in order to heat and light the earth.

The notion of a blazing bonfire at the centre of the solar system outrages one's scientific sense. As one studies the laws of nature that have been discovered, such as those of Newton, Kepler, Ampere, Volta, Dalton, and Boyle, one is forcibly convinced that the ways in which nature works can be expressed by exact laws, and that law and order govern the phenomena of the universe. The laws show harmony in natural phenomena, and a unity throughout the universe, and push out of one's mind ideas of disorder and chaos, and chance occurrences. Indeed men have been so impressed with the orderliness and unity of nature, that they have sought new laws and discovered them. Yet at the centre of the solar system for which it has been found there are laws wonderful in their majestic simplicity and inclusiveness, there is assumed to be incredible complexity and confusion. The beautiful orderliness seen over so great a part of the solar system is violated by chaotic conditions at its centre. There is something wrong in these contradictions of ideas.

A serious difficulty caused by the supposition that the sun is on fire is that attempts to discover relationships between gravity, electricity, magnetism, and similar forces result in complicated theories having to be added continually to difficult theories ; and to-day theories of heat, light, gravitation, electricity, and magnetism have become almost incredibly difficult and complex. This suggests, indeed reveals, that fundamental premises are incorrect and need to be replaced by sounder ones. A correct initial supposition should lead to the simplification, unification, and better understanding of the natures of heat, light, gravity, electricity, and similar forces or forms of energy. In former days, when men assumed the earth was stationary, attempts to explain planetary motions continually required more difficult theories to be added to theories that were already extremely difficult, until few men could understand the final unsatisfactory attempts at explanations. But when the age-old supposition that the earth is stationary was replaced by the more correct one that the earth is itself a planet and in motion around the sun, explanations of planetary motions were much simplified; and the way became open for the discovery by Kepler, Galileo, and Newton of some simple laws governing their motions. It will be shown, in this work, that the replacing of the age-old superstition that the sun is on fire by the supposition that it is not a hot body allows the ways the sun heats the earth, keeps up its heating powers, and causes alternations of hot and cold ages to receive simple and easy explanations. The new knowledge that thus becomes available is likely to allow, in due time, the discovery of laws relating electricity, heat, light, magnetism, gravity and other similar phenomena.

Those who investigate electrical, magnetic, gravitational, and similar phenomena place themselves under an impossible handicap, right from the beginning, if the notion that the sun is on fire is retained. Theories based on this false pre-supposition can lead to nothing except complexities and confusion; but the discarding of the notion of a burning sun can allow easy and probably spectacular advances in new knowledge of the universe.

There is much evidence of profound care for life on earth and for its preservation and continuance. Yet the care for life is made meaningless by the supposed existence at the centre of everything of a mad, whirling, incandescent, tumultuous mass of materials, liable to blaze up, die down, or explode at any moment and extinguish life. An incandescent mass must die out eventually; and the provision for the continuance of life on earth is made to appear purposeless.

There is sanity in the laws of nature that have been discovered, and they indicate the sanity of nature generally. Yet at the centre of things there is supposed to be insanity.

Early geologists taught people that continents and seas, and mountains and valleys were made by violent and chance convulsions of nature. Increased understanding of the ways in which nature works has allowed later geologists to know that the earth's uneven surface has been formed only very gradually by the slow but continuous actions over great periods of time of such forces as rains, rivers, frosts, and the pressure of oceans on their beds; and that there is no need to postulate violent convulsions. The same forces which produced mountains and seas in the past, it is now known, are still at work, changing almost imperceptibly the contours of lands and the heights of mountains and depths of seas. Yet, the knowledge that nature works quietly and nearly imperceptibly to produce great changes is outraged by the need to think convulsions can and must occur, through the existence of an explosive or fiery mass at the centre of the solar system.

Nature is economical and wastes nothing. Everything is used again and again in different forms. Clouds change into rain, the rain falls into the rivers and seas, and the vapour of the rivers and seas is transformed back again into clouds. Not a drop of water is wasted in all the cycle of changes.

Heat is transformed into energy, which can be transformed into work, which can be transformed back again into heat; and no heat or energy is lost. Each new discovery reveals still more nature's economical ways of working and use of materials and forces. And yet, at the centre of the solar system, one is expected to believe there is a prodigal waste of heat, energy, and nearly everything else, poured out aimlessly to no one knows where, and for no purpose that can be imagined.

Where does the sun's heat go, if it is sent out in all directions into space? It is assumed it just goes out into space. What happens to the enormous amounts of dissipated heat? It is a fairly recent discovery that energy and matter are convertible into each other. Does the sun's heat sent into space become matter? Nobody knows. But there is no need to bewilder our minds with such speculations, for the sun does not send away any heat.

The idea that heat could be sent from the sun into empty space is probably untenable. The sun's gravitational actions, for example, cannot extend into empty space, and can be exerted only on other bodies; for a body is required in space for attraction to be exerted there. The sun's attractive power on nothing, by elementary mechanical principles, would be nothing, which means its attractive force is exerted only towards the earth, planets, and other heavenly bodies, and is non-existent in empty space. Anyway, nature would not be so foolish as to exert gravitational forces on things that don't exist, and would not waste effort in applying gravitational forces at points in empty space. Such ideas are contrary to all that has been learnt about the economical and efficient ways in which nature works. It is unlikely therefore that heat can be sent out aimlessly into space by the sun or by the earth or any other heavenly body.

If the sun is losing heat, it should be losing mass, because heat or energy is another form of matter. It has been calculated by astronomers, on the assumption that the sun is losing heat, that it is losing an amount of energy that corresponds to a loss of mass of over 4,000,000 tons a second; but no observations have shown the sun is losing any mass. Hence, for this reason also, the notion that the sun is sending out heat becomes suspect for its truth.

EACH HEAVENLY BODY IS SELF-SUFFICIENT AS REGARDS ITS SUPPLIES OF HEAT

The earth is self-sufficient as regards its supplies of water, air, and other materials; and no water or air or other material is received by the earth from the sun or from any of the other planets or heavenly bodies. The earth's own supplies of water and air are constant in amount, and are used again and again, and never need replenishment from outside sources. Each of the planets similarly is self-sufficient as regards its supplies of water, air, or other materials it may possess; and there is no need to have to think fresh supplies must continually be added from outside sources to keep up supplies.

It is well known that it is the sun's actions that cause the earth's water supplies to change their forms to become clouds, rain, water, ice, or snow, and thus provide for the watering of the ground ; but it is unnecessary to think the sun sends fresh supplies of water each day to the earth in order to keep the earth's water in circulation. Similarly, the sun's actions cause movements of the air, and make the winds blow around the earth : but there is no need to think the sun sends fresh supplies of air to the earth each day to replenish the air that is moved.

If it is realised the earth is also self-sufficient as regards its supplies of heat, the ways in which the sun causes heat on the earth can be fairly well understood. The sun acts on the earth's own supplies of heat to produce daily heat ; and there is no need to think it sends fresh supplies each day. The earth does not receive water, air, heat, or any other kind of material or energy from outside sources ; and all its materials and supplies of energy are used again and again.

NATURE'S USE OF CYCLES OF CHANGES

The reader will readily agree that the earth does not receive any water supplies from the sun or any of the planets, and that it does not lose any water from its system. As regards its water supplies, the earth is a self-contained system. The way the system works is well known. Vapour from the seas, rivers, and moist places, rises and forms clouds, which change into rains, which replenish the seas, rivers, and surface of the earth.

At times water is stored in clouds, in seas, in rivers, in the ground, or in ice or snow ; and the proportions of the earth's water supplies stored in these various places or materials can vary somewhat, but only within certain limits. If, for example, much water is evaporated from the oceans, there will be a correspondingly larger rainfall, which will put back the water into the oceans.

Water, vapour, ice, rain, and most other forms of water can be seen ; and the ways water changes into other forms and eventually back to water are apparent to everyone. Hence fears have not been expressed about the continuance of the earth's supplies, due, say, to loss by evaporation from the oceans ; and there are no reasons for thinking that at any time in the past, the earth's supplies of water have been different from what they are at present.

Somewhat similarly, the earth is a self-contained system as regards its air supplies. Its air is used again and again. But parts of it at times changes their states ; and oxygen and nitrogen and other constituents of the air can at times be found in rocks, bodies of creatures, fibres of vegetation, and other materials. When the rocks disintegrate and the plants and creatures die, the elements subtracted from the atmosphere return to it, and can again help to form ordinary air.

Air cannot be seen, but its presence can be known because of air currents, or winds. But no fears have been expressed that the earth's supplies of air will continually decrease, say by some of its air drifting off into space or being left behind as the earth moves forward through space. It seems that people, without studying the subject deeply, accept as a fact that the earth is self-sufficient as regards its air supply, and does not lose any air into space or need to receive additional supplies continually from the sun or planets or other heavenly bodies or from space itself.

Rocks composing the earth are continually being disintegrated and made into sand and mud ; but new rocks are ceaselessly being made from sand and mud by the pressure of oceans on their beds and land masses on their foundations. There is therefore no need to think fresh supplies of solid materials must continually be received by the earth, from the sun or some other heavenly body, to allow new rocks to be made. Some processes disintegrate materials, but others equally powerful, balance the processes and reunite materials to form rocks again and the materials of rocks are used again and again.

Substances are constantly being decomposed through chemical actions; but the molecules and atoms into which they are decomposed are combined again to make other substances ; and the processes that decompose matter and substances are exactly balanced by other similar processes that effect recombinations. There is no need for complicated theories to try to show that fresh supplies of molecules and atoms must continually be received by the earth from the sun, to allow new substances to be made to replace those that have decomposed. Thus, for example, when a tree is decomposed into molecules and atoms, by being burnt, it is not necessary to think the molecules and atoms have left the earth and gone off into space, and that the sun sends new molecules and atoms to allow a new tree to grow. But this is the sort of argument used when heat is set free from the tree as it is burnt. It is assumed the heat disappears, some of it into space, and that the sun each day sends fresh supplies of heat to the earth. Nature does not work in this foolish way, but uses materials and energy over and over again. No materials leave the earth, and no materials are received by the earth ; and similarly, no energy leaves the earth and no energy is received by the earth. The earth is a self-contained system for energy, or heat, as it is for materials or substances like water, air, or rocks.

Nitrogen and carbon dioxide and oxygen are subtracted in large amounts from the atmosphere and soils by creatures and plants ; but there is no need to fear the earth's air or soils will decrease so much in volume or their constitutions be so altered as to make life impossible ; because creatures and plants eventually give back to the atmosphere and soils all the things they take from them.

The nitrogen cycle, in which nitrogen is subtracted from the air, given to soils, plants and creatures, and returned to the air is well known to students of agriculture, botany, and biology. The water cycle in which water turns into clouds, rain and water again is known to everyone. The molecular and atomic cycle in which elements and atoms are decomposed from substances and recombined to form the same or similar substances is known to chemists. Nature evidently works by cycles, never losing anything, gaining nothing, but continually changing the forms of substances and materials.

All the cycles, it will be noticed, are set in motion and kept going by the sun's actions. Thus, the water cycle, by which clouds are formed from seas and rivers, and rains from clouds replenish the seas and rivers is kept going by the sun ; but the sun does not send any water to the earth to keep the cycle of changes in motion. The cycle of winds, by which the earth's air is kept fresh and moves continually around the earth, is kept going by actions of the sun ; but without any air being sent from the sun to the earth. No nitrogen is sent from the sun to the earth to keep in motion its nitrogen cycle.

THE ENERGY CYCLE

There is also an energy cycle. Heat is a form of energy, and it can be changed into latent heat, potential energy, kinetic energy, chemical energy, electrical energy and other forms of energy, and then be changed back into its original form of heat ; and during its changes of form no heat or energy is gained or lost.

Heat can be stored in most materials. The waters of the oceans are great reservoirs of heat ; and during daylight hours in summer store vast quantities of heat. A little of this is released during the night, and much of it is released during the winter. Much energy is stored in clouds ; as is evident, for much heat must be given to water before it turns into steam or vapour. This energy is given out as the clouds condense into rain. Rocks and soils store great quantities of heat each day ; but release it into the atmosphere fairly quickly if the temperature of the air falls below that of the rocks or soils. The atmosphere itself is a great reservoir of heat, or energy.

Heat can be stored as electrical energy, as is shown when clouds become electrically charged, and lightning discharges occur.

HOW THE SUN HEATS THE EARTH

The earth's energy cycle is kept working by the sun's actions in much the same way as its water cycle, air cycle, nitrogen cycle, and other cycles are kept working ; but without the sun sending any energy, or heat, to the earth. The earth's own supplies of heat, or energy, like its water supplies or air supplies are used over and over again. Just as water, however, changes into vapour, rain, ice, snow, and water again, so somewhat similarly the earth's energy is changed by the sun into various forms like heat, latent heat or electrical, potential or kinetic energy ; and the cycle of energy changes acts continually. Also, in much the same way as the proportions of the earth's supplies of water found in the oceans, ice masses, clouds, and rivers change, but the total amount of the earth's water remains constant, so the proportions of the earth's energy supplies stored at different times in the atmosphere, oceans, soils, and organic rocks change ; but the total amount of energy never varies.

The energy of the atmosphere and soils is not turned into heat until it is acted on by the sun. The free energy of the atmosphere, or in other words the energy that can be acted on by the sun to produce daily heat, is mainly in the lower layers of the atmosphere, and there is less free energy in the rarer layers at heights above the earth's surface. This is evident, because most of the daily heat of the atmosphere is produced near the ground, and less heat is produced in the higher layers of the atmosphere.

It will now be necessary to try and discover how the sun acts on the energy of the atmosphere and soils to produce daily heat.

It is possible it is the electrical charge or potential of the sun which acts on the free energy of the atmosphere and soils to turn it into daily heat.

But there is no need to think any electrical charge or energy is sent from the sun to the earth, or from the earth to the sun, for an electrically charged body, it is well known, can affect another body, whether charged or not, without any electrical energy or charge being lost or received by one or the other. This can be understood by an experiment with a gold leaf electroscope ; and the experiment may also help to show how the earth is heated by the sun.

Nearly every scientific laboratory has a gold leaf electroscope. Its main parts are a pair of gold leaves suspended from an insulated brass rod at the top of which there is a brass cap. The apparatus is often used to show what happens when an electrically charged body is brought near the cap.

When a charged body is brought over the brass cap, but without touching it, the gold leaves diverge or separate. This shows the charged body influences the gold leaves. When it is withdrawn, the leaves return to their original positions. No electrical charge passes from the charged body to the cap or from the cap to the body.

Consider now another charged body, the sun. It affects myriads of particles within the earth's atmosphere and in the upper layers of the soil. But no electrical charge or energy need pass from the sun to the earth. The sun's charge, however, excites or induces electrical actions within the earth's atmosphere, and these actions produce heat. Since the atmosphere is most dense near the earth's surface, the sun can act on more energy and produce more heat in the lower layers of the atmosphere than in layers at a greater height above the rgound. Hence it is warmer at the bases of mountains than at their summits.

Consider another laboratory experiment. When a charged body is brought near a non-conducting body, but without touching it or being connected to it, electrical charges are induced in the non-conductor. The charged body, however, will not cause many electrical actions on the remote side of the non-conductor, because of the shielding effects of the mass of the non-conductor. This suggests the sun does not affect and therefore does not heat the parts of the earth which do not face it, because the shielding effects of the mass of the earth protect them from the influence of the sun.

THE SILVERING OF HEAVENLY BODIES

It is unlikely the earth can lose heat from itself by radiation, or that any other heavenly body, including the sun, could lose heat from its system by radiation.

It is well known that a dark body takes in and sends out heat more quickly than a bright body. A polished kettle, for example, is not so easily heated as a black one ; but if full of boiling water will remain hot for longer than a black kettle filled with boiling water. The maker of a vacuum flask to prevent radiation of heat silvers the walls of the flask. It can be noticed that a heavenly body becomes bright or shines towards a body that produces heat on it, and that it thus automatically receives a kind of silvering which prevents heat being radiated away from it ; and the degree of silvering or brightness is proportional to the amount of heat generated on the body.

The light produced by the sun on the earth causes the earth to shine. This prevents radiation of heat from the earth, for the daylight silvers the parts turned towards the sun ; and the more heat and daylight caused by the sun, the more brilliant the silvering becomes to prevent radiation away from the earth.

The parts of the moon turned towards the sun becomes bright and silvered, and this prevents radiation from the moon. The moon is also illuminated, but to a lesser degree, by the earth. The small amount of “earth shine.’ is sufficient to prevent heat caused by the earth on the moon being radiated back towards the earth and away from the moon.

The sun seen from the earth appears to be a very brilliant body, and to be polished or silvered to a degree no maker of a vacuum flask could hope to rival. Its diameter is more than 800,000 miles, and all the light on the enormous area facing the earth becomes concentrated on a disc which seen from the earth occupies only a minute fraction of the area of the sky. Even if the intensity of light at the surface of the sun were no more than that of the daylight of the earth, the sun would appear to be a brilliant body which could not be looked at with the naked eye from the earth. There may therefore be no need to think the sun is brilliantly lighted, or that it must be at a high temperature

to give light to the earth. Also, its degrees of silvering is probably just that required to prevent radiation of the heat from its surface to the earth.

To an observer on the sun, conversely, all the earth’s daylight would be concentrated on a very small disc, no larger than the disc of one of the planets seen from the earth, and the earth would appear to shine with great brilliancy. The darker, unheated side of the earth, turned away from the sun, is not silvered. The degree of silvering on the side facing the sun, caused by daylight, is probably just what is required to prevent radiation of heat away from the warmer side of the earth.

A little study suggests each heavenly body becomes silvered, or shines, to a degree corresponding to the amount of light produced on it ; and this prevents radiation from it.

HOW THE SUN LIGHTS THE EARTH

From the earth the sun appears as a brilliantly lighted disc. This appearance need not be caused by the sun being on fire or incandescent. It may be an electrical effect producing light for the earth, as perhaps may be explained as follows :

In a laboratory experiment when two electrically charged bodies are made to approach one another, eventually an electric spark passes. At that moment both bodies are illuminated by the spark. But conditions for the spark are only gradually built up, and just before the spark passes glowing conditions are reached which, to a microbe on one of the bodies, might appear as a strong light. If the bodies were kept just far enough apart for the spark to be unable to pass, the charges on the bodies might produce a maintained glow. The sun and the earth are both highly charged bodies, which however do not come near enough to each other for a spark to pass, but come near enough for glowing conditions to be maintained which, to creatures on the earth, produce the phenomenon of daylight.

Similarly, the moon may be electrically lighted by a glow induced by the sun’s charge on the moon’s charge. Moonshine on the earth is caused by the sun’s charge acting on the moon’s charge. Earthshine on the moon may be caused by the earth’s charge acting on the moon’s charge to produce a weak glow.

The density of the earth’s atmosphere decreases with height above the surface ; and the sun acts differently on the atmosphere at different levels. At sea level a main result is the production of heat. The production of heat decreases with height, as the atmosphere becomes more rarified.

As air pressure in a vacuum tube is reduced, a sequence of different phenomena appears between two electrically charged discs in the tube, which may show some of the effects produced by the actions of the sun’s charge on the earth’s atmosphere at different heights above the surface of the earth.

A glow appears in the vacuum tube at a certain stage of decreased air pressure; and it may be that a similar glow is produced by the sun's charge acting on the rarified particles of the earth's upper atmosphere which, seen from the earth, produces the illusion of a glowing sun.

Observations made by cameras, spectroscopes or optical or radar telescopes do not therefore directly or immediately show the condition, temperature, and surface features of the sun; but show effects caused by the sun's charge and earth's charge acting on the rarified gases in the space between the sun and the earth.

PROBLEMS ABOUT THE SUN EASILY SOLVED

Many problems that have hitherto defied solution can now easily be solved. Indeed some of them do not need to be solved. The problem why the sun has not burnt out does not need to be solved. It has not burnt out, because it is not a burning body; and it will not burn out in future.

Again, why have the sun's heating powers varied so little over vast periods of time? The answer is they cannot vary, except by small amounts due to such causes as the sun's varying distance from the earth during the course of a year, and to the variations in the amount of free energy in the earth's atmosphere on which the sun can act.

Attempts have been made to estimate how much heat the sun loses each year, how much heat it sends to the earth, and how much longer its prodigal output of heat can be maintained.

The answers are, the sun does not lose any heat during a year, it does not send enough heat to the earth to boil a kettle of water, and it will for ever continue to heat the earth.

HOT AGES AND ICE AGES

If the notion that the sun is a ball of fire is discarded, and it is accepted that it is a cool or temperate body which generates heat on the earth from the earth's own stores, then the mechanisms which cause alternations of hot and cold ages become known. Further, it can be known that hot ages and ice ages cannot proceed beyond certain safe limits.

Ice ages can be seen to be caused mainly through the subtraction of heat, or energy, from the atmosphere and oceans and soils by vegetation and creatures, and its storage in organic remains like coal, oil, limestone, chalk and coral; hot ages by the release of heat from organic remains.

A considerable proportion of the surface layers of the earth consists of the remains of once living organisms. During their lives the organisms subtract heat, or energy, from their surroundings to make the materials of their bodies or substances. Much of this energy becomes stored in the outer layers of the earth in the remains of the creatures or plants. As energy is subtracted for the growth of the organisms, less becomes available for the sun to act on to produce daily heat; but when the organisms decompose the heat subtracted is returned to the atmosphere, soils, and oceans and can again be acted on by the sun to produce daily heat.

During the making of coal, oil, limestone, and other organic deposits great amounts of energy are subtracted from the atmosphere, soils, and oceans. When these deposits disintegrate the stored energy is given back to the atmosphere, soils and oceans.

Coal has been made from trees and other plants which grew in past ages. As a tree grows it subtracts heat from the atmosphere and ground and stores it. This heat is released when the tree is burnt or when it decays. The same amount of heat is released when a tree decays as would be released by its being burnt; if it decays its heat is released slowly; if it is burnt its heat is released more quickly. But always the same amount of heat is set free by the tree as it burns or decays as was stored in it during its growth.

A full grown oak, ash, elm, or other similar kind of tree stores enough heat during its growth to heat a four or five room dwelling house for several months. This heat was subtracted from the tree's surroundings, and decreased the amount of energy available for conversion into daily heat by the sun. The growing of the tree therefore helped to make the climate colder. The burning of the tree in a household grate however, releases the stored energy, and returns as much energy to the atmosphere as was formerly subtracted from it, and allows a warmer climate.

The energy in coal and oil has been withheld from the sun's actions for ages. When coal or oil is burnt, its energy once again, after long ages, can be acted on by the sun to produce daily heat.

Oil deposits are reservoirs of energy which has been subtracted in ancient times from the heat of the oceans or from the atmosphere or other places containing the earth's stores of free energy. As the oil is burnt, its heat is given out, and as much heat is given out as was subtracted from the oceans or atmosphere.

When a piece of wood or a lump of coal or some oil is burnt, its energy is set free. This free energy does not escape from the earth, but becomes again available for conversion into heat by the actions of the sun during daylight hours, to raise the temperatures of the atmosphere, soils, and oceans. The burning or decomposing of much wood, coal, or oil sets free much energy, which allows the sun to act on a correspondingly larger amount of freed energy to produce a hotter climate. Conversely, if a very great amount of heat is subtracted from the atmosphere, soils, and oceans, and stored, there is less free energy for the sun to turn into daily heat, and the climate is colder.

Most of the limestone of the earth has been made by creatures. That limestone is a storehouse for energy subtracted in past ages from the earth's supplies is shown during the process of slaking quicklime, for when cold water is poured on it, quantities of heat are set free. Immense stores of heat, or energy, it seems are therefore stored in the limestone formations. Probably great stores of energy are contained in coral formations and other organic deposits.

Limestone is more liable to disintegration or decomposition than almost any other rock. During its dissolution as much energy of course is liberated as was stored in it during its making.

Hence when there are great stores of coal and oil and peat and limestone and coral and similar organic deposits in the earth there is little free energy in the atmosphere, soils, and oceans for the sun to act on, and it creates little daily heat, and "shines dimly"; and there is a cold age. On the contrary, when less coal and oil and other organic material is stored in the earth, there is much free energy in the atmosphere and ground and oceans for the sun to act on, and the sun "shines brightly"; and there is a hot age.

During a hot age there is much evaporation from seas, rivers, lakes, and moist earth, and consequently much precipitation of vapour as rain. Much heat and moisture cause rapid growth of vegetation, which results in much storing of energy in trees and plants, and this hastens the laying down of coal measures. Marine life increases as the oceans receive more daily heat during a hot age ; and the making of oil and chalk and coral and limestone is similarly hastened.

But as the storing of heat in forests and other vegetation and in coal and oil measures and in coral and limestone and other organic rock formations proceeds, less energy becomes available for the sun to act on, and the climate grows colder ; and when very much heat has been subtracted from the atmosphere, soils and oceans, an ice age arrives. A hot age therefore automatically proceeds into a cold age, not suddenly, but gradually and almost imperceptibly.

An ice age is therefore caused by the storing of much organic heat ; a hot age by the setting free of previously stored heat.

There are other store places for heat besides forests and coal and oil and organic rocks. As water changes into vapour, or steam, it takes in heat and stores it. Conversely, when vapour changes back into water, it gives out the heat and energy it had received. Hence there is always much heat stored in clouds, and this heat is released as the clouds turn into rain. During hot ages, there is much evaporation and more heat is stored in clouds than during cold ages. Clouds thus serve an important temporary store places for heat or energy.

Heat must be applied to ice to change it to water. This heat is given out if the water changes to ice. Hence, if the ice caps around the North and South poles diminish in sizes, energy must have been subtracted from the atmosphere or oceans or other heat storage places. If the polar caps increase in sizes, it is evidence that much energy has been set free.

Water has a high specific heat, and can store great quantities of heat. The waters of the oceans act as a great reservoir for heat ; and at any time vast amounts of free energy are stored in them. Heat is

stored during the summer, and released during the winter ; and this tends to make summer and winter temperatures less extreme. During a hot age, the oceans store heat, but during a cold age release much of it ; and this tends to make hot and cold ages less extreme.

Rocks, clays, soils, and other materials composing the upper layers of the earth's surface store heat during daylight hours, but release it as the temperature of the atmosphere falls.

The organic energy of the earth is thus continually being stored in different places and materials, for it can be stored in water, rain, clouds, trees, peat, coal, soils, rocks, and air.

The organic energy of the earth is but a small fraction of the energy of the molecules and atoms of inorganic matter. There appears to have been no considerable changes in the amount of matter composing the inorganic rocks, soils, and other materials of the earth, or in the total amount of water in the oceans and ice masses, during long periods in the past. Molecular and atomic changes are occurring continually but the energy therefore stored in the inorganic solids and liquids that compose the earth and its waters has probably remained constant. Hence, fortunately, the cycle of energy changes, by which creatures and plants subtract energy from the earth's stores during their lives, and release it when their organisms decompose, so that it is again available for the sun to act on to produce daily heat, can be studied as a complete system, independently of the cycle of energy changes occurring in the making and decomposing of the inorganic materials of the earth.

The earth's cycle of water changes can be and always is studied as a complete system. The nitrogen cycle, in which nitrogen is subtracted from the atmosphere, put into soils, used by vegetable and animal organisms, and eventually returned to the atmosphere, can also be studied as a complete system. Most and perhaps all of nature's many cycles of materials and processes can similarly be studied as complete systems independently of others ; and hence it is likely the organic energy system can be studied apart from the study of the inorganic energy system.

THE REVERSAL OF AN ICE AGE

It has been shown a hot age automatically proceeds into an ice age through the continued subtraction of free energy by land and sea organisms from the atmosphere and soils and oceans, and its storage in coal and oil and limestone and other fairly permanent energy storage places. It will now be necessary to try to discover how an ice age can return to a hot age.

Evidently, an ice age can return to a hot age only after the release of much previously stored energy.

During an ice age much of the earth's free energy is stored in organic remains in the earth's surface. For a hot age to begin, some of this energy must be released, so that the sun can act on it to produce warmer conditions.

Probably an ice age becomes reversed into a hot age by processes that act almost imperceptibly but on a very large scale. Some of these processes may be simply those of disintegration or decomposition of organic formations by frosts, water, air, chemicals, and similar agents.

Coal decomposes quickly when exposed to the atmosphere ; and indeed undergoes slow combustion from the moment it is exposed to the air in a coal mine ; and thus its energy is released once again into the atmosphere. The energy is released more quickly, of course, if the coal is burnt. Exposure to water and the atmosphere decomposes coal fairly quickly under natural conditions, as the following facts help to show :

Rivers do not run over beds of coal, as they do over beds of granite, sandstone, and other more durable materials ; and seams of coal are not seen exposed along river banks. But undoubtedly many rivers during their histories have cut through seams of coal and temporarily run over beds of coal. But the coal has vanished. It has been decomposed, and has been replaced by mud, sand, gravel, and other materials made or transported by the rivers.

The coal was probably decomposed mainly by acids carried in the waters of the rivers. All rivers and streams and rains have acids dissolved in them, obtained from the atmosphere or decaying vegetation. Some rivers are so strongly impregnated with acids that their waters dissolve rocks like granite. They make short work of coal.

It is well known to geologists that it is the disintegrating and wearing and transporting actions of rains, rivers, frosts, and the atmosphere, the bending of rocks, and the actions of acids that have produced most of the changes in the earth's surface. It is probable similar forces have exposed coal and oil measures and set free their stores of energy and helped to turn ice ages into hot ages.

Oil is an even less stable material than coal, and quickly decomposes if brought to the surface of the ground. Oil is often forced by pressure on deposits up to the ground and thus made liable to decomposition. Oil on the ground is also liable to quick decomposition by burning, which could happen by its being set alight by lightning, surface fires, or man made fires.

As has been pointed out, limestone is a relatively unstable material ; and each day vast quantities are decomposed by rivers, streams, rivulets and rains containing acids ; and as limestone decomposes the energy formerly absorbed is given out.

All the elements together with the correct amount of energy needed for their recombinations as new organic matter are set free as organic matter is decomposed. When a tree decays, materials are set free into the atmosphere and soils together with the exact amount of energy needed to allow a similar new tree to grow, or an equal amount of other organic matter to grow.

Nature has thus a simple but effective way of providing for the growth of new organic matter to replace any destroyed ; and to ensure that new growth shall replace that which has been destroyed. The total amount of organic matter on the earth or in deposits beneath its surface therefore cannot vary very much.

Volcanic eruptions by igniting deposits of organic matter like coal or oil may account for the release of some of the organic energy stored in the earth ; and it is possible the ignition of an oil deposit might itself be the cause of a volcanic eruption.

THE ORGANIC ENERGY CYCLE

It has been shown there is an organic energy cycle ; and that it can be studied as an energy cycle independently of the inorganic energy cycle. In the organic energy cycle, heat or energy is temporarily stored in the atmosphere, oceans, and soils. This is acted on by the sun to produce the daily heat needed by plants and creatures to live and grow. As they grow they subtract heat from their surroundings, and so decrease the supply of energy on which the sun can act. When they die and decompose, their energy is released again into their surroundings, and becomes once more available for the production of daily heat. The total amount of energy in plants and creatures and their remains and in the atmosphere, soils, and oceans, is however constant ; and cannot vary. But if much energy is subtracted from the atmosphere and oceans and retained in organic deposits like coal measures and limestone formations, there is little energy left for the sun to act on, and daily heat is small ; and there is an ice age. Conversely, if there is much decomposition of organic remains, there are large amounts of energy in the atmosphere and oceans on which the sun can act ; and there is a hot age.

The amount of energy in the atmosphere, soils, and oceans depends on the activities of plants and creatures. It might seem that living organisms could subtract all the energy from their surroundings ; but before that could happen they would have difficulty in growing. Hence there are limits to the amount of energy that can be subtracted from the atmosphere and stored in organic deposits, and therefore to the cold stage to which the earth as a whole can go. Also, when much energy has been subtracted from the atmosphere by living creatures, there are great deposits of organic materials in the earth, formed by their dead bodies and substances, and therefore decomposition processes act on greater quantities of organic remains, so that the release of energy is hastened, to produce a warmer climate. Conversely, there are limits to the amount of energy that can be released to the atmosphere and oceans ; because as energy is released the climate becomes warmer, and the multiplication and growth of organisms is hastened, to store again the energy that has been released. Hence the earth's climate can never become too hot or too cold for life to exist, and probably to exist fairly comfortably.

MAN'S INFLUENCE UPON THE CLIMATE

The climate of the earth is therefore decided by the activities of creatures and plants, which regulate it to prevent extremes. As the climate becomes warmer they increase and flourish and subtract energy from their surroundings to reverse the warmer conditions. As the climate becomes colder so their activities decrease. Man's activities hitherto have not noticeably affected the climate.

Man can influence the climate, by setting fire to forests, grass lands, and other vegetation and by burning coal and oil. Energy released in these ways in olden days would be quickly stored again by vegetation and marine organisms. At the present time energy is being released by burning coal in houses and machines, and oil in motor cars and ships' furnaces, and in other similar ways; but the release of energy produces a more extensive and rapid growth of vegetable and marine organisms, and is accompanied by increased absorption of energy by the atmosphere and oceans. This has hitherto prevented noticeable increases in daily temperatures. Also, the amount of energy so far set free by man from coal and oil has been negligible compared with the amount of energy in the atmosphere, ground, and oceans, and still stored in coal and oil and organic rocks. But some observers report decreases in the sizes of the ice caps around the poles, and say the climate is becoming warmer. This may be caused by the burning of coal and oil in increasing amounts.

It is interesting to know that when a motorist uses petrol, or coal is burnt in a fire, there is no loss of energy to the earth; and that the energy set free helps to make the climate warmer, to increase the growth of land and marine life to store again the energy that has been released. Incidentally, the warming of the climate through the burning of coal and oil, if continued, would make artificial heating in houses less necessary. Hence when the climate is cold, there is plenty of coal and oil from which heat can be obtained: when the climate is hot, there is less need of coal and oil, and less is stored in the ground.

LIMITS TO THE DURATIONS OF HOT AGES AND ICE AGES

It can now be understood there are limits beyond which ice and hot ages cannot go. An ice age can go only to a stage when there is so little energy available for the sun to turn into daily heat that land and sea organisms have difficulty in growing. The processes of decomposition of coal and oil and other organic deposits then begin to reverse the ice age, and bring in another warm age. A hot age, it has been shown, automatically destroys itself, and brings in a colder age.

LOCAL HOT AND ICE AGES

The climate of the earth can vary, but only within fairly narrow limits which would not allow polar regions to become very much

colder, or equatorial regions very much hotter, than at present; and the climate of the earth could not become so cold that the entire earth or most of it would be covered with ice, or so hot that tropical conditions would extend to the poles.

But coal and other fossilised materials of hot climates have been found within the present arctic circle; and glacial marks and other evidences of cold periods have been found in Brazil and India and other countries now enjoying tropical climates.

Local hot or ice ages have been caused, according to a theory advanced to-day by some geologists, by movements of the whole earth, so that all places move simultaneously into new latitudes and longitudes, without disturbing the axis of rotation of the earth which remains at an inclination of about 67 degrees to the plane of its orbit around the sun. Thus, London could move to be under one of the pole stars; but at the same time the place opposite London on the other side of the earth would have to move to be under the other pole star; or if London moved to the equator, the place on the other side of the earth would be on the equator. In any such change the earth's axis would continue to point to the present pole stars.

A shift of the earth into a new position could be caused by the raising or lowering of a mountain range or sea bed; but might be made unnecessary if two similar movements occurred at nearly oposite sides of the earth, for the moment of inertia of the earth about its axis might then remain unchanged.

Irreversible redistributions of materials could cause a shifting of the earth. Redistributions of materials occur continually as rivers carry silt out to sea; tides and storms erode coasts and wash their materials into the sea; or glaciers transport rocks and shingle and deposit them at lower levels or out at sea.

A change of the earth's climate could cause changes in prevailing winds and ocean currents which could demand a realignment of the earth about its axis of revolution. If winds and currents over and around Europe and Labrador changed, a great weight of snow and ice would be lifted from Labrador, and a great weight of snow and ice might be put on Europe; and the earth would have to shift bodily to compensate for the redistribution of weight on its surface; and all places would move into new latitudes and longitudes. The shifting might move the rain belt now over the Amazon and Congo basins; and the drying of the basins and the growing of new forests in perhaps the Sahara and Arabia, if the rain belt moved over these regions, would produce other redistributions of weights on the earth's surface, and demand a reduction or an increase in the movement of realignment.

All places therefore, if the above theory is correct, can move into frigid, temperate, or equatorial regions; and many places have within geological times experienced several changes of climate. The theory therefore could explain fairly well why tropical products once grew in what are now frigid zones; and regions in present equatorial zones once or several times experienced arctic climates.

Nature, by ensuring temperatures can vary only within safe limits provides for the preservation and continuance of life on earth. If the sun is assumed to be a fiery mass, there are no reasons to show why life can have survived to the present day, or that it is likely to survive in the future. That life has existed for geological ages is proof that no considerable increase or decrease in the sun's heating power has occurred. Provisions for the control and reversal of hot and ice ages, and hence for the preservation of life, easily become evident if the notion that the sun is a fiery mass is discarded, and more reasonable, sensible and scientific ideas are held.

The question that has disturbed so many people, why there is evidence of care and provision for life on earth, and at the same time carelessness and callousness at the centre of the solar system can now be answered by saying the same care and forethought for life on earth is continued at the centre. The care for life on earth is not limited by earthly provisions; it is continued by solar provisions.

Why is so much purpose and design shown in so many of nature's phenomena; and yet no purpose or design shown at the centre of the solar system? The answer is that purpose and design and co-ordination can now be seen throughout the solar system.

Will a future ice age or hot age be so extreme as to extinguish life on earth? The answer is that there are limits to the stages to which ice and hot ages can go; and that temperatures on earth can never become so low or so high as to endanger life.

Will the supply of solar heat for the earth fail in the future? The answer is the sun has never supplied heat to the earth. Will life on the earth perish when the sun's heating powers fail? The answer is the sun's heating powers cannot fail, and life on earth can exist for ever.

SOME PROBLEMS AWAITING SOLUTION

The realisation that there is an energy cycle for the earth's supplies of organic heat or energy, comparable to its many other cycles, such as its water cycle, air cycle, nitrogen cycle, and molecular and atomic cycle, and that no heat or energy is received or lost by the earth, or indeed by any member of the solar system, and that each member, including the sun, is self-contained as regards its energy, air, water, or other materials it may possess, makes it easier to explain how the sun heats the earth, keeps up its heating powers, and allows alternations of hot ages and ice ages. It reveals or suggests the existence of exact laws where there had been thought to be mere chance occurrences and shows order where chaos seemed to reign.

But there are some problems still requiring solution. No doubt, in due time, solutions to these problems will be obtained. Some of the problems will be briefly mentioned, and possible solutions suggested.

Photographs of the sun taken during an eclipse seem to show flames shooting outwardly from its disc. Why do they seem to show these flames, or prominences? The answer is that they are not flames from a burning sun, but may be effects produced by the electrical charge of the sun.

A corona, a kind of halo, is seen around the sun during an eclipse. The corona is not caused by the sun being on fire; and it is possible that, like the flame effects, it is a phenomenon caused by the sun's great electrical charge. A halo is sometimes seen around the full moon; but nobody suggests the moon is on fire; and the halo can be seen to be produced in the clouds.

An electrically charged body of the size of the sun seen from the earth is likely to produce effects which could be mistaken for flames or halos, especially when the sun is looked at through the varied assortment of gases and ionised particles of the earth's atmosphere.

The spectroscope, so it is said, shows helium and other gases in the sun. Indeed helium first became known by exposing a spectroscope to the sun's actions. Only later, however, did it become known there is helium in the earth's own atmosphere. The manner in which the enormous charge of the sun acts on helium or other elements at a great height in the earth's atmosphere and in rarified states is not known.

THE STARS

The sun's electrical charge produces many and complex effects on the media between the sun and the earth; but what is seen by the eye, or by means of the camera, telescope or spectroscope does not directly show what the sun is like. Each star also produces its own peculiar effects on the media around the earth; but ways of interpreting these must become known before any reliable information can be obtained about the stars themselves.

Calculations of distances of stars using surveying methods cannot now be used, because of the discovery that light rays are bent by matter; and surveying methods hitherto have been used on the assumption that light travels in straight lines through space. Also, space is now said to be curved; but it is not known how light behaves in curved space, except that it could not travel in straight lines. Hence if light is bent as it enters the solar system, and perhaps bent in many directions before leaving other systems, surveying methods are made unreliable.

Again, if the light from a star takes a thousand years to reach the earth, we are now seeing the star only as it was a thousand years ago, and not as it has been for the last nine hundred years. Where is the star now? Does it still exist? It may have ceased to exist five hundred years ago. In any case, in the intervening centuries, it would have moved from the position in which it appears now. Hence none of the stars could be where they are now seen. These and many other similar difficulties are not considered by astronomers who make statements about distances of stars.

The acceptance of astronomical distances has been a stumbling block to the beliefs of many people, not always the least informed or least intelligent. G. B. Shaw said, "When astronomers tell me . . . that a star is so far off that its light takes a thousand years to reach us, the magnitude of the lie seems to me inartistic." G. K. Chesterton, who gives this statement adds, "This remark of Shaw's has been far less followed up than it deserves."

The poets see the stars as objects of serenity and calm beauty, speaking peace to the earth. Their ideas cannot be reconciled with scientific ideas; and the universal testimony of the poets cannot lightly be disregarded.

The reader may remember how Walt Whitman when listening to a lecture on astronomy had to leave and go out and look up at the stars, to regain touch with reality :—

"When I heard the learn'd astronomer.
When the proofs, the figures, were ranged in columns before me,
When I was shown the charts and diagrams to add, divide, and measure them,
When I sitting heard the astronomer where he lectured with much applause in the lecture room
How soon unaccountable I became tired and sick,
Till rising and gliding out I wandered off by myself
In the mystical moist air, and from time to time,
Look'd up in perfect silence at the stars."

Was Shakespeare writing nonsense when he made a character say :-

"When beggars die, there are no comets seen ;
The heavens themselves blaze forth the death of princes ?"

Is the biblical account of the Magi seeing a star in the east which foretold the birth of Christ, nonsense, or worse ?

Religion has never found itself able to agree with scientific ideas about the universe, creation, or man's place in the universe.

If science finds itself in disagreement with the poets and religion, it would be wise for science to look into its own fundamental suppositions. A task ahead for scientists is to regain touch with reality ; and find explanations for phenomena of the universe which will satisfy not only themselves but the poets and theologians. Only then will science find firm foundations for its own beliefs.